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ABSTRACT

A brief outline of the Australian educational system, emphasizing the organization of science education in the various states, provides the framework for a description of the origin, role, and function of the Australian Science Education Project (ASEP) established jointly in 1969 by the Federal and State governments. The aims of the project, all consistent with the broad aim "to design science experiences which contribute to the development of children," are listed, and the relationship of the environmental and social themes to the aims and procedures of ASEP is discussed. Criteria for the selection of topics to be developed are illustrated by synoptic descriptions of some tentatively planned units. Brief comments on the involvement of teachers and planned formative evaluation of the units are made, and the intended open-ended and open-sided nature of some units is discussed. The project will terminate in 1973 when units will be available for use in grades seven through ten. A shorter version of this paper appeared in "Science Education", Volume 56, 1972. (AL)

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SCIENCE EDUCATION INFORMATION REPORTS

OCCASIONAL PAPER SERIES - SCIENCE PAPER
ASEP--A NATIONAL CURRICULUM DEVELOPMENT PROJECT IN AUSTRALIA

by

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SCIENCE, MATHEMATICS, AND ENVIRONMENTAL EDUCATION INFORMATION REPORTS

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Robert W. Howe
and
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Editors

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ASEP--A NATIONAL CURRICULUM DEVELOPMENT PROJECT IN AUSTRALIA*

by

A. M. Lucas

In the January, 1971 issue of The Science Teacher Professor Alfred Garrett, (1) Past-President of the National Science Teachers Association (NSTA), commented briefly on the work being done by the Australian Science Education Project (ASEP). He stated that while in Australia he "observed some of the best preplanning for curriculum study" he had seen anywhere. This paper will outline the development of this project, and describe its function and approach. To place the Project in perspective a brief account of the organization of education, and science education in particular, in Australia will be given.

Organization of Education in Australia

Australia is a Federation with a constitution modeled, in part, on that of the United States. The powers to be exercised by the Federal authorities were specified, with all others, including education, being left to the six States.

Most children attend government schools, operated by the State departments of education, although about one quarter attend non-government schools, most of which are conducted by religious denominations. Attendance is compulsory for children between the ages of six and at least fifteen; in Tasmania the minimum leaving age is sixteen. In most States children may start formal schooling at four and one-half, and most begin primary school by age five. In three States there are six years of primary school, followed by six of secondary schooling; the other three States have a seven-five pattern.

The secondary school is usually a comprehensive or multi-purpose high school, although Victoria has a bi-partite system of government secondary schools. Victorian High Schools are comprehensive, but the Technical Schools emphasize technical, agricultural, or commercial subjects, while offering the basic subjects of English, mathematics, social studies, and science.

Each State has a state-wide externally set and marked examination at the end of the twelfth year. The scores on this examination, which has a different name in the several States, are used as the basis for selection for University entrance. At present there are quotas on

*A shorter version of this paper appeared in Science Education, Volume 56, 1972.

entrance to almost all University courses, and to many non-university tertiary institutions, such as teachers colleges and institutions of technology. (These non-university tertiary institutions are now being called Colleges of Advanced Education.)

Most States have an earlier external examination at the end of the tenth or eleventh year, but this is decreasing in importance. In Victoria many schools are accredited by the Victorian Universities and Schools Examination Board (VUSEB) to assess their own students on their own curriculum for the award of the VUSEB's Leaving Certificate, and in New South Wales the teacher's assessment carries equal weight with the score on the external examination for the award of the School Certificate.

The presence of these external examinations necessitates a common syllabus or course of study for each examination subject for all schools within the State at the grade level at which the examination is conducted. It also has the effect of tending to produce a common curriculum for each subject at lower grade levels, notwithstanding the fact that many of the students do not take the external examination later. There is not, however, a common total curriculum for every student in the State, as there is variation in subjects chosen, particularly in grades 11 and 12 where specialization is evident. Some students specialize earlier than this.

Most States publish guidelines for the syllabus to be used in the government schools, and this is often followed by non-government schools as well. The degree of prescription varies from State to State: each Victorian High School must make its own decisions on school organization and curriculum content, at least up to grade 10 or 11; all students follow the same fields of study through grade 10 in New South Wales.

Organization of Science Education in the Secondary Schools

At the risk of oversimplification, the following generalization is offered: through grade 10 a general science course is offered; in grades 11 and 12 separate courses in the scientific disciplines are available. The situation in New South Wales is an exception and it will be described later.

The general science course may take various forms, but is usually, at least on paper, an integrated course, attempting to inter-relate topics from the physical, earth, and life sciences. This is a comparatively recent development in most States: previously separate concurrent courses in the disciplines were offered at all grades in the secondary school. Victoria eliminated this practice in 1943, and the other States have done so in the last decade.

In New South Wales there is an integrated science course for grades 7 to 10, but in grades 11 and 12 only one course, "Science," is offered. This is offered at three levels. The third, (lowest) level is an integrated course designed to give a deeper understanding of man's place in nature and the impact of science on man and his culture. The level two and level one courses are multistrand, with a common core of physics and chemistry, and a choice of either biology or geology. Integration, where it occurs, is the responsibility of the teacher. (The Science course for grades 11 and 12 is currently under revision, and it is possible that this pattern may change.)

In the other States a science-oriented student commonly takes a program containing two mathematics courses, physics, chemistry, English, and perhaps one other course such as a history, a modern language, economics, art, or music in each of grades 11 and 12. Biology is rarely taken by science students, but is often taken by humanities-oriented students to satisfy a University entrance requirement of a science at grade 12, or by lower ability students who do not intend to apply for University entrance.

Federal Government Role

Although education is constitutionally a State matter, the financial role of the Federal government has been increasing. It has established the Australian Universities Commission and the Advisory Committee on Advanced Education which advise the Federal government on the needs of the Universities and the Colleges of Advanced Education respectively. Through these organizations the Federal government contributes to the capital and recurrent expenses of tertiary education. It also provides a number of scholarships to academically-able undergraduate and graduate students. Through grants to the States, and directly to non-government schools, the Federal government is providing capital for building science laboratories and libraries in secondary schools, with some provision for equipment of both.

The funding of ASEP represents the first contribution of Federal money towards the provision of curricular materials. The only previous interstate curricular projects were funded by the Australian Academy of Science, which supported the adaptation of the BSCS materials, and a publishing company, which is currently developing a series of inter-related materials suitable for use in the senior science courses in a number of States. (The Education Departments of Victoria and South Australia contributed to the adaptation of the BSCS materials by providing some staff to work part-time on the project.)

Origins of ASEP

Prior to the interstate projects mentioned above, almost all curriculum development in science (and other subjects) was characterized by its haphazard nature: a few departmental officers, University staff, and selected teachers, meeting infrequently, would prepare a syllabus containing lists of topics to be taught in the course, with

some statements concerning the manner in which the course should be taught. There was usually a number of experiments that had to be performed and recorded.

The most notable exception to this pattern was the Junior Secondary Science Project (JSSP), the forerunner of ASEP. This project was established in 1966 by the Science Standing Committee of VUSEB and the Australian Council of Educational Research (ACER) to produce learning materials for the first four years of a revised Victorian secondary school science course. (At that time, VUSEB suggested a course that was followed in broad outline by many Victorian schools.) Financial assistance was provided by a number of Australian Foundations and commercial firms, ACER and the Education Department of Victoria. The education department contribution was in the form of the time of teachers or professional staff released from other duties to work at the project headquarters, provided by ACER.

The JSSP materials provided opportunity for students to proceed at their individual rates through the course of study, and also provided enrichment, remedial, laboratory, and field work. Student materials consisted of a series of cards and booklets. Certain basic topics were to be completed by all students. Approximately 25 percent of the students were directed, via topic tests, to remedial units before they proceeded to the next basic learning experience in the sequence. Other students were directed to various enrichment activities or required to conduct some independent open-ended research.

Materials for the first two years of the course were taken through trial versions and were published by F. W. Cheshire (Melbourne).

These JSSP materials were tried in some South Australian and Tasmanian schools as well as in many schools in Victoria. Following favorable reports these three states jointly approached the Federal government for financial assistance to establish a more comprehensive project to complete the work initiation by JSSP. Three principles were affirmed:

(1) That the project produce a range of instructional materials sufficient in quantity to satisfy all or a major portion of the requirements for a course or courses in secondary school science up to and including Grade 10.

(2) That the project must take account of the similarities and differences in the present and projected provisions and patterns of science education in the States up to and including Grade 10.

(3) That none of the States would prescribe the materials for use in schools, or guarantee their use, believing that each school should be free to choose what it considered the most suitable course, topic, method,

> and approach. Each state considered that the use of the materials must arise from their quality (2, p. 9).

Funds were provided from July, 1969, and the positions of director and seven professional staff advertised in March, 1969. Total funds of $1.2 million (U. S. $1.34) were provided. All six states agreed to cooperate in the new project. The Federal government agreed to provide $150,000 per year for five years, and the six states to contribute the remainder in cash or services, including releasing officers from other duties.

The change from a Victorian to an Australian project, with the responsibility to provide materials suitable for a range of courses and conditions, resulted in the cessation of JSSP development and a complete and careful reappraisal of the role of the project, which was renamed the Australian Science Education Project.

ASEP Guidelines

To help determine the direction of development of ASEP a "guidelines conference" attended by ASEP staff, education department officials from each state, science educators from universities and teachers' colleges, and classroom teachers experienced in teaching science to Grades 7-10, was held in January, 1970. At this conference a set of proposals from the project executive was presented along with alternate viewpoints from non-project participants. The discussion of these presentations produced statements of the working aims and provided general directives to the executive.

The aims have evolved still further and the statement of aims reproduced in this paper is taken from the second Project Newsletter (3).

Aims of ASEP

> "The broad aim of the project is to design science experiences which contribute to the development of children. More specifically, the science experiences are aimed at developing:
>
> (1) some understanding of man, his physical and biological environment, and his inter-personal relationships
>
> (2) skills and attitudes important for scientific investigation
>
> (3) some understanding of the nature, scope and limitations of science
>
> (4) some understanding of, and concern for, the consequences of science and technology
>
> The following two statements are to be considered in conjunction with these aims.

(1) The kind of understanding at which the Project aims enables children to operate more effectively in their environment.

(2) To arouse and foster the interest of children is of prime importance in the development of understanding, skills, and attitudes (3, p. 3)."

These aims are deliberately designed to be simple, general statements which will broaden rather than constrict the outlook of teachers. They are general statements for the whole ASEP program upon which more specific objectives for individual units can be based.

The project aims at encouraging inquiry, and developing skills and attitudes that will enable the individual to inquire efficiently and solve relevant problems. The concept of science as a dynamic developing discipline is encouraged, but the recognition that some problems are not open to scientific investigation is also to be considered.

Themes and Approach

ASEP is strongly committed to an environmental approach, using environment in a broad sense to include "the internal (biological, psychological) as well as the external (physical, technological, biological, social, etc.) (4, p. 8)." Its environmental scheme relates to five ways in which man functions: as individuals; as members of interacting groups; with man-made procedures and devices extending his sensory perceptions; in a technological society, the products of which affect man and the natural environment; and in a naturally changing environment. "Only by understanding the natural changes can a child begin to understand man's impact upon the natural environment (3, p. 6)."

The project has selected six themes which it believesprovide a framework to assist the organization and selection of subject matter for the units to be developed:

(1) The matter in the universe can be organized into units.

(2) The units in the universe can be organized into hierarchical sequences.

(3) Events in the universe may be described and predicted.

(4) Motion is an essential part of most phenomena.

(5) Units of matter interact within the dimensions of time and space.

(6) Interactions between units of matter tend toward a state of equilibrium.

Psychological Foundations

The development of the materials is based upon the findings of Piaget and Inhelder on stages of intellectual development. Most students who will be working with the ASEP materials for the concrete and formal stages of Piaget's developmental sequence. ASEP materials will be developed at three levels: the first based on the assumption that children are at a concrete stage; the second designed for pupils at the transitional stage; and the third for students who are at Piaget's formal stage. Within each unit extensions of a basic core will be graded and teachers alerted to activities suitable only for students at the formal stage. Some units will be developed that will be suitable only for students at this highest stage. (The Project hopes to develop tests to indicate the stage of logical thought reached by individual students.)

Selection of Topics

A unit will be chosen for development if it:

(1) is consistent with the environmental scheme,

(2) will allow children to see new relationships,

(3) has content meaningfully related to children's everyday experiences,

(4) is of potential interest to children,

(5) contains student activities contributing to the development of skills and abilities,

(6) has content, skills and activities which are judged valuable by the project staff and teachers,

(7) uses simple equipment whenever possible,

(8) is feasible in terms of children's characteristics, school financial limitations, school equipment, school organization, and the characteristics of the present teachers.

Tentative Units

The list of tentative units in Table 1 demonstrates the scope of the project. When reading this list it is important to remember that the project is not producing a unified sequential course of study, but materials from which teachers may select units

according to their own aims, and the aims and curricula demands of their particular school. It will be possible for a teacher to structure several alternative courses out of the materials, although some units should be taken in sequence. The suggested time for each unit will allow for "open-ended" research activities.

An important characteristic of some of the planned units is that they will be "open-sided" as well as "open-ended." ASEP's stated aims are consistent with the view that science is a part of the general education of secondary students, and many of the units could support teaching in other subject areas. In the words of the director,

> "We believe that science provides only one way of looking at the world. That science has links with social science, art, music, and many other areas is important, and leads to exciting possibilities in schools. For example, motion is not simply a scientific concept, but an artistic, musical, or poetic one depending on your point of view. These are areas that teachers and schools can be encouraged to explore in the development of their own curricula. . . . The Project believes it has a duty to attempt to develop at least some materials which bridge different areas of knowledge (4, p. 7)."

The integrated nature of the proposed units and their relation to the environmental scheme is best illustrated by reference to the synoptic specifications of some of the units. Plant Dyes considers their extraction and use and also serves as an introduction to the measurement of acidity. Non-verbal interaction of groups by Signals Without Words (facial expressions and gestures) will be studied and its importance in establishing relationships and determining group structures considered. The effects of chemicals on the physiology and responses of humans will be considered along with the social effects of addiction in Drugs. In Controls, students will use an understanding of feedback and amplification, developed by using transistors, to learn about physiological homeostasis and automation. Physical principles will be applied to both the human organism and engineering design in the unit Supporting Structures, and the inter-relationships of the principles of mechanics (momentum, inertia, friction) and physiology and psychology (reaction time) will be shown in Traffic.

Australian Seashores will consider the effect of the sea on coasts, and critically examine man's interaction with the Australian coast, while the relationships between landform, flora and fauna will be discussed with reference to resource management and conservation in Australian Landscapes. The diversity and inter-relationships of organisms in freshwater habits studied in Life in Freshwater will lead to reference to the effects of water pollution. Other effects of pollutants will be considered in Solar Energy, which, as well as

a study of the source of earth's energy, will examine the insulation afforded by the atmosphere, and relate this to the effect of pollutants and atmospheric gases.

Evaluation Activities

Among activities already conducted by the evaluation staff are the sampling of opinions of teachers of junior science and the prediction of readability of science materials. The opinion of teachers was sampled at in-service conferences by the distribution of mail-back questionnaires. Many of these opinions are consistent with the position taken by ASEP, with the majority of teachers believing that the materials should be integrated and relevant to the child's environment, that a range of units rather than a course be produced, and that the behavioral sciences can be included in a science curriculum.

Other evaluative functions to be undertaken by the Project include development of suitable tests and other instruments for use with completed materials in the schools, and the construction of the tests necessary to determine the stage of cognitive development that each student has reached. The evaluation team will also monitor the two trials that each unit will undergo before being offered for publication and production.

The Project was not funded for an extensive evaluation effort of the final products, or for basic research relating to instruction, but it is actively encouraging outside organizations to conduct such studies with the hope of supplementing the contribution of ASEP's own evaluation group.

Involvement of Teachers

> "The Project believes that the most important variable in the classroom is the teacher. We believe that the development of science materials cannot occur in isolation, and must parallel the education of teachers to use the materials. Indeed . . . (classroom teachers have) . . . a vital and active role in all aspects of the Project. Not only will they try out materials developed by the Project, they will also suggest materials to be developed. They will try out different structured sequences to establish different pathways, or alternative ways of using the materials that are developed (4, p. 10)."

The importance attributed to the classroom teacher as a professional practitioner in this statement made at the guidelines conference has been demonstrated in many ways. Even before any materials had been produced in trial form, or even planned in detail, a number of in-service-conferences had been held.

At these conferences the aims of the project were explained, feedback obtained, and the aims modified in the light of this feedback. The Project Newsletter is designed to encourage further dialogue. It contains requests for information under the heading "YOU tell US." For example,

> "To what extent do you want to relate science to social problems such as conservation of resources, drugs and overpopulation? What proportion of your science teaching time are you preparing to devote to such matters? (3, p. 14)."

Classroom teachers will also be involved in development in more direct ways as members of working parties to be set up in each state. These working parties, under the guidance of their State Advisory Committees, will assist with the development of materials. Each working party, with the exception of that set up in Western Australia, which investigated the feasibility of adapting ISCS materials for use in conjunction with ASEP materials*, will probably be responsible for the development of all materials required for one complete unit selected from a list supplied by the Project. These working parties will have access to the project production facilities in Melbourne while writing their units and preparing aids. The first trial of these units will probably be in the state of origin. Working parties may suggest other tasks instead of unit development.

Significance of ASEP

To an Australian not connected with ASEP, the Project's most significant points are these:

(1) The recognition of the teacher as a professional, capable of making his own judgments. The provision of carefully tested and structured resource units will allow the teacher to choose materials that will fit into his own program, without being forced to take a complete "package," parts of which may not suit his local situation. The affirmation that the educational authorities believe "that each school should be free to choose what it considered the most suitable course, topic and method of approach" reflects an administrative recognition of the professional responsibilities of teachers. If this is followed, some of the descriptive comments about the school systems made at the beginning of this paper will be outdated, and it will not be possible to make such generalizations again.

(2) If ASEP is successful, this first co-operative program between all major educational authorities in the country, the Federal government, and state governments may lead to further material development in other disciplines, perhaps including primary education.

*The problems involved in adapting ISCS could not be overcome and ASEP is no longer attempting this.

(3) The recognition that science learning materials should contribute to the personal and social development of children, not just their intellectual development, leading to a consideration of some of the social sciences in science materials.

(4) The integration of the consequences of man's interactions with other men and with the environment as a natural part of science instruction, and not something added as a special topic which can easily become an apologia for, or a polemic against, science, which is, after all, an important cultural invention of man affecting our lives whether we like it or not.

Materials Available

Units are not expected to become commercially available until 1974, ready for use at the beginning of the school year in February, 1975. It is expected that delivery of materials to publishers/manufacturers should be made during 1973. The first four units listed in the table are now being given their first trial in schools adjacent to the project headquarters. After revision the second trial will be made in many different types of schools in all States.

Copies of the ASEP Newsletters and a report on the guidelines conference may be obtained from the Director, Australian Science Education Project, 11 Glenbervie Road, Toorak, Victoria, Australia, 3142.

References

This account has been prepared from descriptions given in the ASEP Newsletters, the papers presented at the guidelines conference, and some brief reports of project activities in Australian science teachers' journals. In some cases paraphrases of these materials were made. Direct quotations were made from the following sources:

(1) Garrett, A. B. "Notes on Travels in Australia," The Science Teacher, 38, (1): 7, 1971.

(2) Dale, L. G. "Future Developments of JSSP," JSSP Newsletter, Number 3, 1969.

(3) ASEP Newsletter, Number 2, 1970.

(4) Howard, H. O. "The Purposes of the Australian Science Education Project." Paper presented at the ASEP Guidelines Conference, January, 1970.

TABLE 1
Tentative Titles of Items Which May Be Produced by ASEP

Level	Unit Title
1	Messengers
	Mice and men
	Safety
	The soil
	An electrical model
	Microbes and food preservation
	Plant dyes
	Forces and jobs
	Sound
	How long is it?
	Temperature and heat
	Plants
	Minerals and crystals
	Water
	Rocks formed from sediments
	Illustrations in colour
	Energy--Where does it come from?
	Little boxes
	Light and heat from electric currents
	Signals without words
	Insects
2	Drugs
	Spreading force
	Light forms images
	Making life easier
	Where humans come from
	Man's energy needs
	Fossils and the history of the earth
	Life in freshwater
	Australian landscapes
	Australian seashores
	Winds and weather
	Earth's interior--Igneous rocks
	Cells and replication
	Sexual reproduction
	Intrinsic properties
	Give and take (transfer of energy)
	Sticking together (interaction)
	Sand castles
	Supporting structures
	Models
3	Population control
	Traffic
	The human machine
	Genetics
	Evolution of continents
	The universe
	Solar energy
	Plant fibers
	Controls
	Metals in the service of man

The search for raw materials
Plastics

(This list is not definitive; the analysis of the first specifications of these units is aimed at eliminating unnecessary overlap between units, and of the extent to which each idea, ability or attitude is to be developed in each unit. Level one corresponds roughly to grades 7 to 8, level two to grades 8 and 9, and level three to grades 9 to 10.)